agricultural pesticide and herbicide use in areas that drain into the Mokelumne River.

RATIONALE: *Poor water quality has been identified by USFWS (1997) as a limiting factor affecting fall-run chinook salmon and steelhead in the Mokelumne River. USFWS (1995) stated that managing Camanche Reservoir elevations and Pardee Reservoir inflows have not consistently provided suitable water quality to the Mokelumne River Fish Facility and to the lower river. Occurrences of low dissolved oxygen, elevated hydrogen sulfide, and elevated heavy metal levels have been documented, occasionally resulting in fish kills. Presently, reservoir operations have successfully maintained the Camanche release water quality to the lower Mokelumne River. Recently, EBMUD and others have adopted a long-term plan to remediate Penn Mine contamination. The final EIR/EIS has been completed and a Restoration Plan adopted by EBMUD, CVRWQCB, CSM, and federal ESA.*

HARVEST OF FISH AND WILDLIFE

TARGET 1: Develop harvest management strategies that allow the spawning population of wild, naturally produced fish to attain levels that fully utilize existing and restored habitat and allow harvest to focus on hatchery-produced fish (◆◆◆).

PROGRAMMATIC ACTION 1A: Reduce or eliminate the illegal salmon and steelhead harvest by increasing enforcement efforts.

PROGRAMMATIC ACTION 1B: Develop harvest management plans with commercial and recreational fishery organizations, resource management agencies, and other stakeholders that support ecosystem restoration and protect important species.

PROGRAMMATIC ACTION 1C: Evaluate a marking and selective fishery program for chinook salmon.

RATIONALE: *Restoring and maintaining chinook salmon and steelhead populations to levels that take full advantage of habitat may require harvest restrictions during, and even after, the recovery period. Involvement of the various stakeholder organizations should help provide a balanced and fair allocation of available harvest. Target population levels may preclude existing harvest levels of wild, naturally produced fish. For populations supplemented with hatchery fish, selective fisheries may be necessary to limit wild fish harvest, while harvesting hatchery fish to reduce their potential to disrupt the genetic integrity of wild populations.*

ARTIFICIAL PROPAGATION OF FISH

TARGET 1: Minimize the likelihood that hatchery-produced salmon and steelhead could stray into adjacent non-natal rivers and streams to protect naturally produced salmon and steelhead (◆◆◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative program to evaluate the benefits of limiting stocking in the Mokelumne River with salmon and steelhead produced at the Mokelumne River Hatchery.

TARGET 2: Employ methods to limit straying and reduced genetic integrity of wild and hatchery supported stocks (◆◆◆).

PROGRAMMATIC ACTION 2A: Rear hatchery salmon and steelhead in hatcheries on natal streams to limit straying.

PROGRAMMATIC ACTION 2B: Limit stocking of salmon and steelhead fry and smolts to natal watersheds to minimize straying that may compromise the genetic integrity of naturally producing populations.

PROGRAMMATIC ACTION 2C: Develop a plan to stop importing egg or fry chinook salmon and steelhead to the Mokelumne River.

RATIONALE: *In watersheds like the eastside tributaries to the Delta, where dams and habitat degradation have limited natural spawning, some hatchery supplementation may be necessary. This would help to sustain fishery harvest at former levels and to maintain a wild or natural spawning population during adverse conditions, such as droughts. However, hatchery augmentation should be limited in extent and to levels that do not inhibit recovery and maintenance of wild populations. Hatchery-produced salmon and steelhead might directly compete with and prey on wild salmon and steelhead. Straying of adult hatchery fish into non-natal watersheds might also threaten the genetics of wild stocks. Hatchery fish might also threaten the genetic makeup of stocks in natal rivers. Further research and experimentation are necessary to determine how this issue is addressed. Long-term* *hatchery augmentation of healthy wild stocks may genetically undermine those stocks and threaten the genetic integrity of other stocks.*

Straying of adults into non-natal streams may result in interbreeding with a wild population specifically adapted to that watershed, and thus lead to the loss of genetic integrity in the wild population. Release of hatchery-produced fish into the San Joaquin River and its tributaries, other than the Mokelumne River, could lead to a loss in the genetic integrity of wild salmon and steelhead populations.

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◆ San Joaquin River Ecological Management Zone

Introduction

The health of the Sacramento-San Joaquin Delta is dependent on its tributaries for inflows of water along with their sediments and nutrients. The tributaries also provide spawning, rearing, and migration habitats for aquatic species. The Delta also depends on quality riparian corridors that connect it with the upper watershed habitats needed by many terrestrial species. The ecological integrity of the San Joaquin River below Friant Dam is critical to the ecological health of the Bay-Delta system. The ecological quality of the mainstem San Joaquin River below the mouth of the Friant Dam is particularly important for the anadromous fish that annually migrate into and out of the Stanislaus, Tuolumne, and Merced rivers.

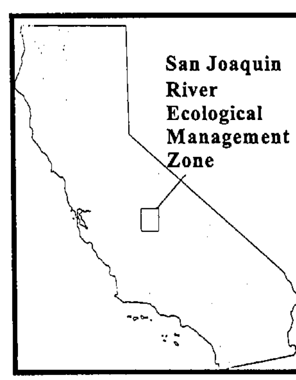
The San Joaquin Ecological Management Zone encompasses four Ecological Management Units:

- Vernalis to Merced Ecological Management Unit,
- Merced to Mendota Pool Ecological Management Unit,
- Mendota Pool to Gravelly Ford Ecological Management Unit, and
- Gravelly Ford to Friant Ecological Management Unit.

Description of the Management Zone

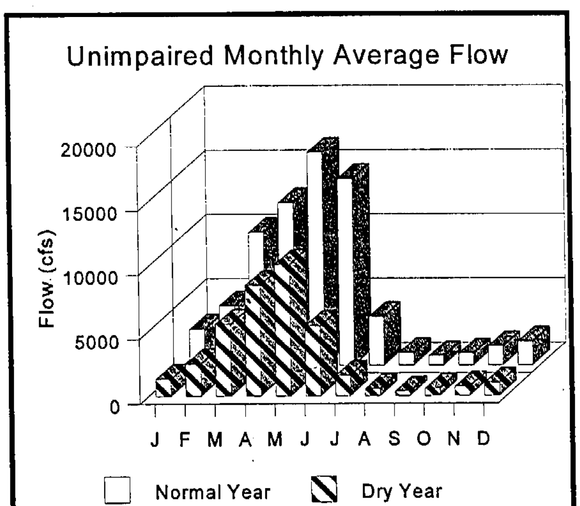
The 290-mile-long San Joaquin Valley occupies the southern half of the Central Valley and has an average width of 130 miles. The Tulare Lake basin to the south is normally considered a separate drainage basin but, during wet years, has contributed occasional floodflows and subsurface flows to the San Joaquin River. The San Joaquin River basin is bounded on the west by the Coast Ranges and on the east by the Sierra Nevada. The San Joaquin River flows west from the Sierra Nevada, turns sharply north at the center of the valley floor, and flows north through the valley into the Sacramento-San Joaquin River Delta.

On the arid west side of the basin, relatively small intermittent streams drain the eastern slopes of the Coast Ranges but rarely reach the San Joaquin River. Natural runoff from westside sloughs is augmented by contaminated agricultural drainage and spill flows. On the east side, many streams and three major rivers drain the west slope of the Sierra Nevada and flow into the San Joaquin River. The major eastside tributaries south of the Delta are the Stanislaus, Tuolumne, and Merced rivers. Secondary streams south of the Merced River include Bear Creek and the Chowchilla and Fresno rivers and the upper San Joaquin River.



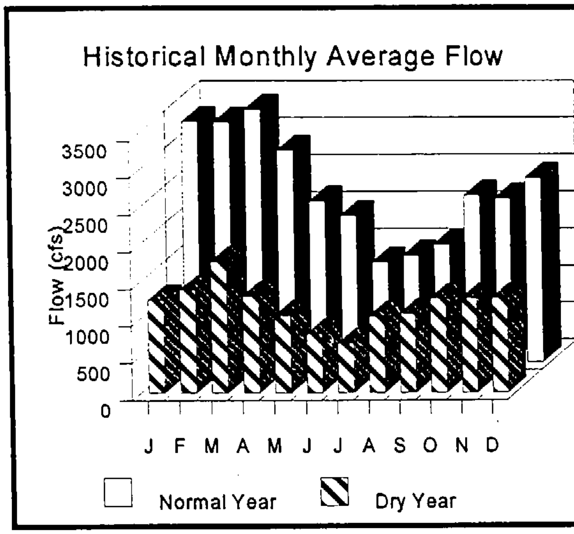
Precipitation in the San Joaquin River basin averages about 27.3 inches per year. Snowmelt runoff is the major source of water to the upper San Joaquin River and the larger eastside tributaries. Historically, peak flows were in May and June, and natural overbank flooding took place in most years along all the major rivers. When floodflows reached the valley floor, they spread out over the lowlands, creating several hundred thousand acres of permanent tule marshes and more than 1.5 million acres of seasonally flooded wetlands and native grasslands. The rich alluvial soils of natural levees once supported large, diverse riparian (waterside) forests. As much as 2 million acres of riparian vegetation are estimated to have grown on levees, on floodplains, and along small stream courses. Above the lower floodplain, the riparian zone graded into higher floodplains supporting valley oak, savanna, and native grasslands interspersed with vernal pools. Less than 10% of the historic wetland acreage and less than 2% of the historic riparian acreage exist as remnant vestiges.

Agricultural development in the basin, which began in the 1850s, brought dramatic changes in the hydrologic system. The upper San Joaquin River drainage (1,650 square miles) now has seven power-generation reservoirs, which alter flows in the upper basin. Friant Dam near Fresno is the major storage reservoir there. Completed in 1949, the dam is operated by the U.S. Bureau of Reclamation (Reclamation) to provide flood control, irrigation, and power generation. Millerton Lake, formed by Friant Dam, has a gross storage capacity of 520,000 acre-feet (af) and provides for deliveries into the Friant-Kern Canal, the Madera Canal, and other Central Valley Project (CVP) facilities. Mean annual runoff of the San Joaquin River into Millerton Lake totals 1.9 million af, with 2.2 million af per year committed in water contracts.



Unimpaired Streamflow on the San Joaquin River at Vernalis, 1972-1992 (Dry year is the 20th percentile year; normal year is the 50th percentile or median year.)

Water development caused a great change in the natural streamflow pattern of the river. The high flows of spring are now captured in storage reservoirs in the basin except for the years of highest rainfall. Summer and fall flows are higher than before to provide water for irrigation and urban water supply.



Historical Streamflow on the San Joaquin River at Vernalis, 1972-1992 (Dry year is the 20th percentile year; normal year is the 50th percentile or median year.)

Historically, the upper San Joaquin River supported spawning and rearing habitat for the southernmost stocks of spring- and fall-run chinook salmon and for steelhead. Early dams along the river restricted passage of adult salmon. By the early 1940s, large runs of salmon in the upper San Joaquin River near Fresno were mostly spring-run fish. This spring run, ranging from 2,000 to 56,000 fish between 1943 and 1948, was extirpated after 1949 when the Friant Dam closed the channel. The fall run, averaging about 1,000 spawning adults in the 1940s, was also eliminated by the dam. Streamflow releases to the San Joaquin River below the dam are now insufficient to support salmon passage, spawning, or rearing. No water passes through the Gravelly Ford to Mendota Pool reach except during extremely high runoff periods.

There is historical documentation of steelhead in the San Joaquin river system, south to and including the Kings River and Tulare Lake (Yoshiyama et al. 1996). The widespread distribution of chinook salmon in this system provides further indication of the extent of steelhead distribution. In the Klamath River drainage, for instance, all streams that contain a chinook salmon population have steelhead as well and, in nearly all cases, steelhead go higher into the drainage and utilize more of the stream system than do chinook salmon. This indicates that if chinook salmon were able to access and utilize habitat of a particular stream, steelhead could as well. Because steelhead utilize smaller tributaries for spawning and rearing, they were probably more widely distributed in the San Joaquin River system (and the rest of the Central Valley) than were chinook salmon (Yoshiyama et al. 1996).

Friant Dam's closure of the channel and reduction of total basin outflow damaged anadromous fish runs in other tributaries as well. Reducing fall attraction flows and spring outflows on the mainstem San Joaquin River reduced adult returns, production, and survival of salmon throughout the system. When spring outflow at Vernalis on the mainstem San Joaquin River is high, the total adult salmon escapement (fish that survive migration to spawn) in the San Joaquin River basin increases 2.5 years later. Since Friant Dam began operating, low spring outflows from the basin in most years have contributed substantially to low salmon production.

The three major eastside tributaries to the San Joaquin River—the Stanislaus, Tuolumne, and Merced rivers—support spawning and rearing habitat for fall-run chinook salmon, steelhead, rainbow trout, and perhaps late-fall-run chinook salmon. Substantial evidence exists to show that there is an extant self-sustaining steelhead run in the San Joaquin Basin. Since 1995, a small, but consistent, number of juvenile steelhead that exhibit smolt characteristics have been captured in rotary screw traps at two chinook salmon monitoring sites on the lower Stanislaus River (Demko and Cramer 1997; 1998). The presence, over multiple years, of juvenile steelhead that have undergone smoltification and are actively migrating to the ocean is sufficient evidence to conclude that natural production is occurring and a self-sustaining population exists. This is also the opinion of the Department of Fish and Game (CDFG 1997), the Steelhead Project Workteam of the Interagency Ecological Program (IEP Steelhead Project Workteam 1999) and apparently the Department of Water Resources and the U.S. Bureau of Reclamation (DWR and USBR 1999). It is the opinion of the Department of Fish and Game that small runs of steelhead still exist in the Tuolumne and Merced rivers as well (CDFG 1997).

Recent genetic analysis by the National Marine Fisheries Service of Stanislaus River rainbow trout/steelhead collected from the anadromous reach below Goodwin Dam show that this population has close genetic affinities to upper Sacramento River steelhead (NMFS 1997). Further, this Central Valley group forms a genetic group that is distinct from all other samples of steelhead analyzed (132 samples from Washington, Oregon, Idaho, and California) (Busby et al. 1996), hence may be representative of native Central Valley steelhead. In most years, a few salmon are observed spawning in late January and February on the lower Stanislaus River. Whether these fish are a remnant of a distinct late fall run in the San Joaquin River basin or whether they are strays or fall-run fish spawning later than usual is not known.

In recent years, fall-run chinook spawning escapements in the San Joaquin River basin have declined to alarmingly low levels. In fall 1991, an estimated 658 fish returned to the basin to spawn, compared to 135,000 in 1944, 80,500 in 1953, 53,400 in 1960, and 70,000 in 1985.

A streamflow of 35 to 230 cubic feet per second (cfs) is required in the river between Friant Dam and Gravelly Ford to support riparian water diversions. Major reaches of the river between Gravelly Ford and the confluence with the Merced River are essentially dry for much of the year. The stream channel has been affected by inchannel gravel mining and by vegetative encroachment resulting from the absence of frequent scouring flows. The mainstem San Joaquin River downstream from the confluences with the major eastside tributaries provides the migration corridor for anadromous fish to the Delta and the Pacific Ocean.

In recent years, drainage practices in western Merced County have increased agricultural return flows from Salt and Mud Sloughs into the mainstem San Joaquin River. These flows attracted significant numbers of adult salmon into the sloughs and, subsequently, into irrigation canals with no suitable spawning habitat. As spawning runs have declined, the proportion of the San Joaquin drainage salmon straying into the westside area has increased. In fall 1991, 31% of the salmon in the basin was estimated to have strayed into westside canals.

Fish screens were installed on the El Solyo, West Stanislaus, and Patterson Irrigation District diversions in the late 1970s. Because of the low number of returning adult salmon and juveniles the inappropriate design and inefficiency of the screens, and the high cost of maintenance; the screens were abandoned within a few years. The El Soyo diversion has the capacity to withdraw as much as 80 cfs; each of the other diversions has a capacity of 249 cfs. Together, these diversions can withdraw a significant proportion of the mainstem river flow, particularly in dry years.

Many small and medium-size irrigation diversions on the mainstem San Joaquin River entrain juvenile salmon in addition to those at the El Soyo, West Stanislaus, and Patterson Irrigation District diversions. Cumulative losses at these other sites may be significant.

San Joaquin River basin outflow standards should be established to protect adults migrating upstream in the fall and emigrating smolts in the spring.

High water temperatures during emigration probably reduce smolt survival in the mainstem river. California Department of Fish and Game (DFG) Exhibit 15 to the California State Water Resources Control Board (SWRCB) for Phase I of the Bay-Delta hearings showed that, in years when the flow at Vernalis was 5,000 cfs or less in May, water temperatures were at levels of chronic stress for these fish. Temperature stress is additive and increases with successive exposures to diversions, predation, handling in the Delta fish salvage process, and migration delays.

List of Species to Benefit from Restoration Actions in the San Joaquin River Ecological Management Zone

- chinook salmon
- steelhead trout
- splittail
- white sturgeon
- American shad
- giant garter snake
- Swainson's hawk
- greater sandhill crane
- western yellow-billed cuckoo
- shorebirds
- wading birds
- waterfowl
- neotropical migratory birds
- San Joaquin Valley woodrat
- riparian brush rabbit
- native resident fishes
- plants and plant communities.

Restoring and maintaining important ecological processes and functions in the San Joaquin River Ecological Management Zone depend on conditions in both the main tributaries to the river (the East San Joaquin Basin Ecological Management Zone) and the downstream Sacramento-San Joaquin Delta Ecological Management Zone. Water flow, channel incision, levee construction, gravel mining, sediment and nutrient supply, and input of contaminants from the tributary streams all influence habitat conditions in the mainstem San Joaquin River. Changes of these factors in the tributaries from historical conditions have degraded habitat on the mainstem river. Conditions in the Delta have a significant effect on anadromous fish production in the basin because, in most years, a significant proportion of inflow from the San Joaquin River is diverted at the Delta.

Descriptions of Ecological Management Units

Vernalis to Merced Ecological Management Unit

The Vernalis to Merced Ecological Management Unit (43 miles, from river mile [RM] 75 to RM 118) is the nontidal reach of the river that includes the confluences with the Merced, Tuolumne, and Stanislaus rivers. These major tributaries drain the west slope of the Sierra Nevada and provide most of the flow to this reach. On the arid west side of the basin, relatively small intermittent streams drain the eastern slopes of the Coast Ranges but their waters rarely reach the river, which flows in this reach through a broad alluvial channel and floodplain. Levees set close to the main channel confine the floodplain throughout most of its length, including along the lower tributaries.

Merced to Mendota Pool Ecological Management Unit

The Merced to Mendota Pool Ecological Management Unit (87 miles, from RM 118 to RM 205) includes the mouth of Salt Slough and the Chowchilla and Fresno rivers. Flows in this reach have been significantly reduced from historical conditions by the Friant Dam project upstream and by the Eastside Bypass and levee system. The reach receives inflow from the Delta-Mendota Canal into Mendota

Pool. Irrigation deliveries in the local area use this reach as a conduit. Agricultural drainage practices in western Merced County result in significant return flows from Salt and Mud Sloughs into this reach.

MENDOTA POOL TO GRAVELLY FORD ECOLOGICAL MANAGEMENT UNIT

The vision for the Mendota Pool to Gravelly Ford Ecological Management Unit (24 miles, from RM 205 to RM 229) includes no significant tributary inflow. Because of the Friant Dam project upstream, most of this reach is dry for much of the year. The stream channel has been altered by inchannel gravel mining, floodplain confinement by levees and incision, and vegetation encroachment into the abandoned channel and floodplain.

GRAVELLY FORD TO FRIANT ECOLOGICAL MANAGEMENT UNIT

The Gravelly Ford to Friant Dam Ecological Management Unit (31 miles, from RM 229 to RM 260) includes no significant tributary inflow. At Friant Dam, almost all the mainstem riverflow is diverted into the Friant-Kern Canal. Except during spill conditions at Friant Dam, the reach from the dam to Gravelly Ford receives a flow release of 35-230 cfs to support riparian water diversions; any streamflow reaching Gravelly Ford sinks into the channel bed because of the highly permeable substrate (bottom material) in that area. The stream channel has been altered by inchannel gravel mining, incision, and vegetation encroachment into the channel and floodplain.

Significant stressors of ecological functions, habitats, and species on the San Joaquin River are:

- artificial confinement of the river channel within levees
- dams the block access to historical habitat
- poor land use and livestock grazing practices on riparian lands,
- lack of floodflows, which alters the natural sediment balance and reduces riparian vegetation growth, and
- reservoir management and diversions on the mainstem and tributary streams that significantly reduce streamflow and alter stream temperature.

Additional stressors are:

- direct removal and fragmentation of riparian habitat for agricultural and urban development and floodway maintenance,
- entrainment of fish and other aquatic organisms in water diversions, and
- inchannel and floodplain gravel extraction, which alters channel forms.

Channel instability and floodplain disturbance have caused bank and floodplain deposits to erode and release too much fine sediment into the river. This sediment damages spawning habitat and bars fish passage. Construction of levees close to channels, as well as flood bypasses and weirs, has fragmented and degraded floodplain habitats (e.g., by causing unnaturally high salt concentration in surface soils). Levees have also caused excessive scour of the channel and instability of riparian and aquatic habitats within the leveed channel. In some reaches, native vegetation is being replaced by non-native invasive plants, such as giant reed. This reduces the quality of fish and wildlife habitat, increases sediment deposits, and decreases floodway capacity.

Important habitats provided by the San Joaquin River and its ecological processes include riparian and riverine aquatic habitats; riparian forest; valley oak woodland; perennial grassland; various cropland habitats (e.g., agricultural wetlands and uplands); and migration, holding, spawning, nursery, and emigration habitats for anadromous and resident fish populations.

Important fish, wildlife, and plant species occupying the San Joaquin River Ecological Management Zone and its habitats include steelhead, fall-run chinook salmon, splittail, white sturgeon, green sturgeon, and American shad.

VISION FOR THE ECOLOGICAL MANAGEMENT ZONE

The vision for the San Joaquin River Ecological Management Zone includes restoring important fishery, wildlife, and plant communities and ecological processes to healthy conditions and reducing stressors that inhibit health and limit restoration. This will require reactivating natural ecological processes, including streamflow and natural stream meander, to accomplish most of the restoration. In addition, stressors such as unscreened diversions and levee confinement of the floodplain must be reduced. The vision includes significant improvements in floodplain and stream-channel habitats consistent with flood control, urban, and agricultural development plans in the San Joaquin Valley floodplain.

Throughout the San Joaquin River, restoring a healthy riparian zone and improving stream meander corridor will increase the shaded riverine aquatic (SRA) habitat, the woody debris, and the natural sediment regime (pattern) in the aquatic system.

In the lower part of the zone from the Merced River to Vernalis, restoring the stream meander corridor will benefit upstream and downstream migration of fall-run chinook salmon and steelhead and restore spawning and rearing habitat for American shad, striped bass, white and green sturgeon, and splittail. Reducing losses of fish to water diversions, improving streamflows at critical times of year, reestablishing a functional floodplain and a balanced sediment budget, and improving water quality by reducing input of contaminants to the river will also benefit fish and wildlife.

In the reach from the Merced River confluence to Mendota Pool, emphasis will be on reducing the input of contaminants from westside drainage and reducing straying of fall-run chinook salmon upstream of the confluence with the Merced River.

In the reach from Friant Dam to Gravelly Ford, the vision focuses on maintaining native resident fishes and waterfowl and wildlife habitat by restoring minimum streamflows, stream-channel configuration, and the riparian corridor.

Visions for Ecological Management Units

Vernalis to Merced River Ecological Management Unit

The vision for the Vernalis to Merced River Ecological Management Unit would:

- restore the ecological processes needed to support spawning and rearing habitat for American shad, white and green sturgeon, and splittail and the migratory corridor for upstream and downstream migration of fall-run and late-fall-run chinook salmon, steelhead, and resident rainbow trout.
- restore and maintain streamflows that provide habitat and adequate temperature levels for migrating salmon and steelhead and resident native fishes,
- maintain a diverse, self-sustaining riparian zone,
- reestablish a functional floodplain,
- restore a balanced sediment regime,
- reduce entrainment of aquatic resources at water diversions, and
- reduce the input of salt and other contaminants.

Restoring fall-run chinook salmon and steelhead runs in the San Joaquin River basin could contribute significantly to recovery of Central Valley stocks. In the past, natural fall-run spawning escapements in the basin have accounted for as much as 27% of the total natural escapement of fall-run chinook salmon in the Central Valley.

Floodway capacity should be expanded by a combination of:

- levee setbacks,
- levee abandonment where new land use and public ownership justify restoring the floodplain,
- widening and extending the bypass system throughout this reach, and
- establishing a new design floodflow capacity that includes a firm commitment to natural vegetation not subject to maintenance or removal.

These measures are environmentally superior alternatives to rebuilding and riprapping existing banks and levees without modifying the undersized flood-control infrastructure damaged by the 1997 floods.

The vision sets a high priority on connecting fragmented riparian and seasonal floodplain habitat corridors and restoring ecological structures and processes, such as natural channel meanders and unconfined lower floodplains, that promote self-sustaining riparian succession and creation of aquatic habitat. Wildlife refuges and undeveloped historical floodplains that support seasonal wetlands and other natural habitats, but that have inadequate water supplies and high surface salt concentrations, will be flooded by the restored flood cycles from modified flood control system described above.

Instream sand and gravel mining on the major tributaries in this reach should be phased out and replaced by off-channel, high-terrace mines and relocation to other sources. Such sources may include reservoir delta deposits or abandoned floodplain terraces where the channel is unnaturally confined by recent downcutting. Abandoned inchannel pits that cause channel instability and trap fish should be filled, where this is feasible, or modified and restored to create stable habitats and landforms. Revegetation programs and levee and grade modifications should be implemented at abandoned mine pits to provide greater bank cohesion and channel stability and to route low flows away from potential fish entrapments.

Merced River to Mendota Pool Ecological Management Unit

The vision for the Merced River to Mendota Pool Ecological Management Unit would reduce the input of contaminants, which will improve aquatic habitat quality in this unit and downstream in the Vernalis to Merced River Ecological Management Unit and in the Sacramento-San Joaquin Delta Ecological Management Zone. Other parts of the vision are to restore ecological processes that create and sustain the habitats of a diverse, self-sustaining riparian corridor linked with upstream and downstream Ecological Management Units; to reduce the straying of adult fall-run chinook salmon into areas with no suitable spawning habitat; and to improve land management and livestock grazing practices along streams and riparian zones.

Other requirements are to maintain a diverse, self-sustaining riparian habitat zone, to reestablish a functional floodplain, to restore a balanced sediment regime, to reduce entrainment of aquatic resources at water diversions, and to reduce the input of salt and other contaminants.

Floodway capacity should be expanded by a combination of:

- levee setbacks,
- levee abandonment where new land use and public ownership justify restoring the floodplain,
- widening and extension of the bypass system throughout this reach, and
- establishment of new design floodflow capacity that includes a firm commitment to natural vegetation not subject to maintenance or removal.

These measures are environmentally superior alternatives to rebuilding and riprapping existing banks and levees without modifying the undersized flood-control infrastructure damaged by the 1997 floods.

The vision sets a high priority on reconnecting fragmented riparian and seasonal floodplain habitat corridors and restoring ecological structures and processes, such as natural channel meanders and unconfined lower floodplains, that promote self-sustaining riparian succession and the creation of aquatic habitat. Wildlife refuges and undeveloped historical floodplains that support seasonal wetlands and other natural habitats, but that have inadequate water supplies and high surface salt concentrations, will be flooded frequently by the restored flood cycles from the modified flood control system described above.

Mendota Pool to Gravelly Ford Ecological Management Unit

The vision for the Mendota Pool to Gravelly Ford Ecological Management Unit would restore the ecological processes needed to support a diverse, self-sustaining riparian corridor linked with upstream and downstream Ecological Management Units and that does not encroach on the stream channel. The vision would also improve land management and livestock grazing practices along streams and riparian zones.

Instream sand and gravel mining should be phased out and replaced with off-channel, high-terrace mines and relocation to other sources. Such sources may include reservoir delta deposits or abandoned floodplain terraces where the channel is unnaturally confined by recent downcutting. Abandoned inchannel pits that cause channel instability and trap fish should be filled, where feasible, or modified and restored to create stable habitats and landforms. Revegetation programs and levee modifications should be implemented at abandoned mine pits to provide greater bank cohesion and channel stability and to route flows away from potential fish entrapments.

GRAVELLY FORD TO FRIANT DAM ECOLOGICAL MANAGEMENT UNIT

The vision for the Gravelly Ford to Friant Dam Ecological Management Unit would restore a diverse, self-sustaining riparian corridor linked with upstream and downstream Ecological Management Units. The vision would also maintain streamflows for resident native fishes and improve livestock grazing practices along streams and riparian zones.

Instream sand and gravel mining should be phased out and replaced with off-channel, high-terrace mines and relocation to other sources. Such sources may include reservoir delta deposits or abandoned floodplain terraces where the channel is unnaturally confined by recent downcutting. Abandoned inchannel pits that cause channel instability and trap fish should be filled, where feasible, or modified and restored to create stable habitats and landforms. Revegetation programs and levee modifications should be implemented at abandoned mine pits to provide greater bank cohesion and channel stability and to route flows away from potential fish entrapments.

VISIONS FOR ECOLOGICAL PROCESSES

CENTRAL VALLEY STREAMFLOWS: Instream flows are inadequate and need to be supplemented where possible, consistent with existing agreements. The vision is that instream flows will be high enough to support the restoration of ecological processes and functions that maintain important fish, wildlife, and plants along with their habitats.

COARSE SEDIMENT SUPPLY: The vision is that existing sources of coarse sediments will be protected and cooperative programs or conservation easements will be developed to reduce the amount of coarse sediments harvested from the active stream channel.

NATURAL FLOODPLAINS AND FLOOD PROCESSES: Natural river-floodplain interaction has been impaired by the construction of dams and levees. Seasonal flooding is needed to promote ecological health and restoration of important species. The vision is that floodplains along the San Joaquin River will be expanded, reconnected to their channels, and seasonally flooded by increased stream flows that will regenerate natural riparian habitat, carry nutrients to the Delta, and create seasonal habitat for splittail spawning and the rearing and emigration of juvenile fish.

STREAM MEANDER: Natural stream meander in the San Joaquin River is constrained by dams, flood-control levees, and altered flow patterns. The vision is to create and maintain any possible meander to sustain habitats similar to those that occurred naturally to provide sediment for the Delta and rearing habitats for chinook salmon and steelhead.

CENTRAL VALLEY STREAM TEMPERATURES: High stream temperatures limit or interrupt the natural life cycle of aquatic organisms. The vision is that water temperatures below major dams will be suitable for maintenance of important aquatic organisms and biological functions such as steelhead rearing and chinook salmon spawning, egg development, and fry and juvenile rearing and emigration.

VISIONS FOR HABITATS

SEASONAL WETLAND HABITAT: The vision is that increased seasonal flooding and enhancement of existing wetlands, and development of cooperative programs with local landowners will contribute to increased habitats for waterfowl and other wetland dependent fish and wildlife resources such as shorebird, wading birds, and the giant garter snake.

RIPARIAN AND RIVERINE AQUATIC HABITATS: Riparian plant communities are important components of a healthy ecosystem and contribute in many ways to sustaining fish and wildlife populations. The vision is to restore diverse self-sustaining riparian and riverine aquatic habitat along the San Joaquin River which will serve as an important migratory corridor to upstream habitats for terrestrial and aquatic species.

FRESHWATER FISH HABITAT: Freshwater fish habitat is an important component needed to ensure